

**WORK PLAN FOR
SITE 1 HYDROGEOLOGICAL INVESTIGATIONS
NAVAL AIR WARFARE CENTER
TRENTON, NEW JERSEY**

PROJECT DESCRIPTION

The New Jersey District of the U.S. Geological Survey (USGS) will provide technical oversight and assistance to the U.S. Navy as requested for Hydrogeological Investigations of Site 1 at the Naval Air Warfare Center (NAWC), Trenton, New Jersey. The USGS will provide technical oversight and assistance for on-site work, data collection and interpretation, and report results.

INTRODUCTION

A recent Remedial Investigation/Feasibility Study has detected high concentrations of trichloroethylene (TCE), dichloroethylene (DCE), vinyl chloride and other contaminants in ground water at NAWC Trenton. The major area of ground water contamination was identified in the vicinity of Site 1 NAWC Trenton Brine Handling Area. Concentration of TCE dissolved in ground water are greater than 750,000 micrograms per liter and increasing contaminant concentration with depth in the subsurface suggests a high potential for the existence of dense non-aqueous phase liquid (DNAPL) contaminants to be present at the site. Recent Site 1 Interim Action well monitoring suggests the potential for off site migration of contaminants.

On the basis of existing geologic and hydrogeologic data it is clear that the existing ground water contamination plume and potential DNAPL plume are controlled by the underlying geologic structures and fractured rock aquifer. DNAPL in fractured rock poses exceptionally difficult problems for site investigation and remediation because fracture networks are complex, DNAPL retention capacity is generally small, and depth to which DNAPL may penetrate can be very large.

A need exists for refining the understanding of the ground-water flow system and particularly the fractured-rock framework at NAWC Trenton for the purpose of the efficient and accurate delineation of contaminated ground water and DNAPL plumes.

OBJECTIVES

In order to more fully understand the movement of contaminants in the subsurface below NAWC Trenton the primary objective of this study is to provide data and interpretation for a detailed hydrogeologic framework of the site. This information is to be used to define the extent of the ground water and DNAPL contaminant plumes both horizontally and vertically.

APPROACH

In order to characterize the extent and mobility of the contaminant plume underlying NAWC Trenton a two phase approach is planned. Phase I will utilize existing rock core data, borehole and surface geophysics and aquifer testing data to develop a preliminary hydrogeologic framework. This framework is necessary to refine the understanding of geologic conditions, the ground water flow system and to facilitate the optimum placement of future deep monitoring wells on and off-site. Phase II will involve plume characterization through utilization of new hydrogeologic data from the deep borehole installations, advanced borehole geophysics data, detailed fractured-rock framework development and future additional studies designed to assess plume contaminant and remediation.

PHASE I

Borehole Geophysics

Natural gamma-ray logging of 12 existing deep monitoring wells will be performed in order to develop a cross-sectional framework of the subsurface at Site 1. Characteristic signatures related to lithologic variations and fracturing will be used to objectively define the lateral continuation and connectivity of bedding and geologic units from borehole to borehole. This information in conjunction with existing rock core data will provide a much improved framework with respect to geologic structure and definition of the strike and dip of beds.

Surface Geophysics

An electromagnetic induction (EM-31) survey will be conducted to attempt to determine the location of a mapped geologic fault-splay directly adjacent to the western boundary of NAWC Trenton. This fault may have a major impact on the mobility and direction of movement of contaminated ground water and DNAPL. The survey will encompass the boundary of NAWC Trenton and include the Airport and other government properties between Bear Tavern Road, Parkway Avenue, and Scotch Road in Ewing Township, New Jersey. The apparent conductivity measured by the EM-31 survey should be higher in the fault zone as opposed to adjacent areas. EM-31 will also be used to attempt to delineate the contact between the sandstone of the Stockton Formation and the shale/mudstone of the Lockatong Formation. This formational contact also appears to control flow in the subsurface.

Aquifer Testing and Water Quality Sampling

Contractors for the U.S. Navy will perform additional aquifer testing and sampling as suggested in preliminary meetings for this study. Additional aquifer testing is necessary because well MW-15-BR, the previous pumping well used in tests, has only a short discrete open interval. It is suggested to perform additional testing using other wells along strike and dip of well MW-15-BR to record their effect on the ground water system. Of particular importance is well BRP-1 which is open to 70 feet of fractured rock. It will be important to see how other monitoring wells react to pumping induced stress on this well. The USGS will provide field technical support as requested by the Navy for these tests.

Preliminary Report-Geologic Framework

On the basis of Natural Gamma-Ray Logging, Surface geophysics, analysis of continuous rock core data aquifer tests, and water quality data a preliminary conceptual model of the geologic framework will be developed. Structural analysis including the construction of cross sections and geometric projections will be developed to assist in the areal and vertical placement of approximately 10 new deep rock wells. The location and depth of these wells are critical for the proper delineation of the vertical and lateral extent of ground water contamination and DNAPL plumes.

PHASE II

The USGS will provide technical field support to the Navy and work in conjunction with Navy contractors during drilling of the new deep on and off site monitoring wells. Drilling and well construction, aquifer testing and sampling will be performed by contractors for the U.S. Navy

Advanced Borehole Geophysics

Advanced Borehole Geophysics techniques will be used by the USGS on new uncased boreholes to (1) locate subsurface fractures (2) identify water bearing fractures (3) identify zones of potential borehole flow and (4) identify stratigraphic correlation of rock units within each borehole. These data will also assist in the selection of the most appropriate depths to screen monitoring wells.

The following geophysical logs will be run by the USGS:

- (1) caliper
- (2) natural gamma
- (3) single-point resistance
- (4) Fluid temperature and fluid conductivity

EM, flow meter, and Televiwer logging will be performed based on the availability of these tools at the time of the logging.

Packer testing of discrete zones within these new deep rock boreholes may provide important information on borehole flow conditions and water quality.

Detailed report-fractured rock framework

On the basis of Phase II drilling and advanced borehole geophysics a detailed fractured-rock framework will be developed. The framework in conjunction with new ground-water quality data will be used to develop a detailed cross-sectional analysis of the ground-water flow system, contaminant plume and any DNAPL plume that may exist. An interpretive report detailing data collection and results of this study will be prepared by the USGS for the US NAVY.

ADDITIONAL WORK

Additional studies suggested by regulatory agencies include a "state of the art" DNAPL investigation. Results from the hydrogeological investigation and plume characterization studies can be used to determine best methods for plume containment and remediation. For example in situ bioremediation may be a cost efficient alternative for plume cleanup at site 1 NAWC. Hydrogeologic data and laboratory experiments utilizing bedrock core and water quality data can be effective in determining the rate of TCE movement and the rate of TCE degradation at the site. Initial findings strongly suggest biodegradation of volatile organic compounds is occurring at NAWC, Trenton. This advanced DNAPL investigation and the possibility of 3-dimensional ground-water flow simulation and transport modeling can be planned and scoped out in greater detail as the Phase I and II studies progress.

PROJECT COST

The USGS has received \$30,000 funding in FY95 for providing the U.S. NAVY technical assistance in the hydrologic sciences at NAWC, Trenton. As a significant portion of this funding was for Phase I RI/FS document review and that the RI/FS was not forwarded to the USGS for review, funding is available to begin the Phase I borehole and surface geophysical investigations at NAWC, Trenton. Additional funding in the amount of \$150,000 is requested to complete Phase I and Phase II work as described in this workplan. Funding for additional investigation of a "state of the art" DNAPL study and ground water modeling are not included in this scope of work. The USGS will submit periodic reports detailing hours spent, actions completed and expenditures to date.

Personnel (salaries)	\$67,500
Borehole Geophysics (Phase II)	\$107,500
Packer Testing	\$12,500
Indirect Costs	\$67,500
TOTAL	\$255,000



United States Department of the Interior



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SUBJECT: SOW

NUMBER OF PAGES TO FOLLOW: 4

SPECIAL INSTRUCTIONS:

IF THERE IS A PROBLEM, CALL 609-771-3902

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